

# QUICK TRAFFIC RECOVERY AFTER THE NIIGATAKEN CHUETSU-OKI EARTHQUAKE IN 2007

**Yoneo OKA, Yu SHIBUYA, Kazuhiro ONOZUKA**  
*East Nippon Expressway Company Limited, Niigata Bureau*

## ABSTRACT

Unprecedented “*The Niigataken Chuetsu-oki Earthquake in 2007*” hit off the Sea of Japan near Kashiwazaki City on the 16<sup>th</sup> July 2007 and this devastated earthquake damaged infrastructures including Hokuriku express highway and national highway in and out of the city. The earlier recovery of those roads is essential to the activities needed for recovery from the damages including lifesaving.

On this occasion, Niigata bureau of East Nippon Expressway Company Ltd made the damaged Hokuriku Expressway open with an extraordinary speed. This paper describes the main factors essential for this successful earlier traffic opening of the expressway. Those comprised the earlier establishment of the infrastructure of disaster countermeasures, and cooperative works of the bureau and the regional maintenance office, on inspections of every corners of the expressway. As a result of these activities the expressway was opened for the emergency vehicles in 4 hours after the earthquake hit.

## 1. INTRODUCTION

A large-scale magnitude 6.8 earthquake occurred at about 10:13 a.m. on Monday July 16 (Marine Day), 2007, with its epicenter located offshore of Niigata (intensity 6 upper (1019 gal) in Kashiwazaki, Niigata). The Hokuriku Expressway extends near the epicenter, and damage was found at some 330 places on about a 95-kilometer section, between the Nou IC and the Nagaoka JCT, of the expressway. Damage was caused to many places including the pavement, bridges, and tunnels (Fig. 1).

After the occurrence of the earthquake, the Niigata office of East Nippon Expressway Company Limited immediately announced an emergency alert, called necessary personnel, and set up a disaster countermeasures office, and thereafter, emergency inspection and restoration work were conducted quickly and accurately.

As a result, approximately 4 hours later, an emergency route was secured along the entire line hit by the earthquake, and the suspension of the line was completely removed by setting the two-way traffic regulation and single-lane regulation at 18:00 p.m. on July 18, which was about 56 hours after the earthquake. During the summertime traffic congestion period (the bon holiday from August 10 to 20), which was 25 days later, 4 lanes were temporarily opened, and since the affected area is a snowy region, temporary restoration work was completed on December 5, which was before the full-fledged snow season.

This report presents how the quick traffic recovery was achieved after the Niigataken Chuetsu-oki Earthquake.

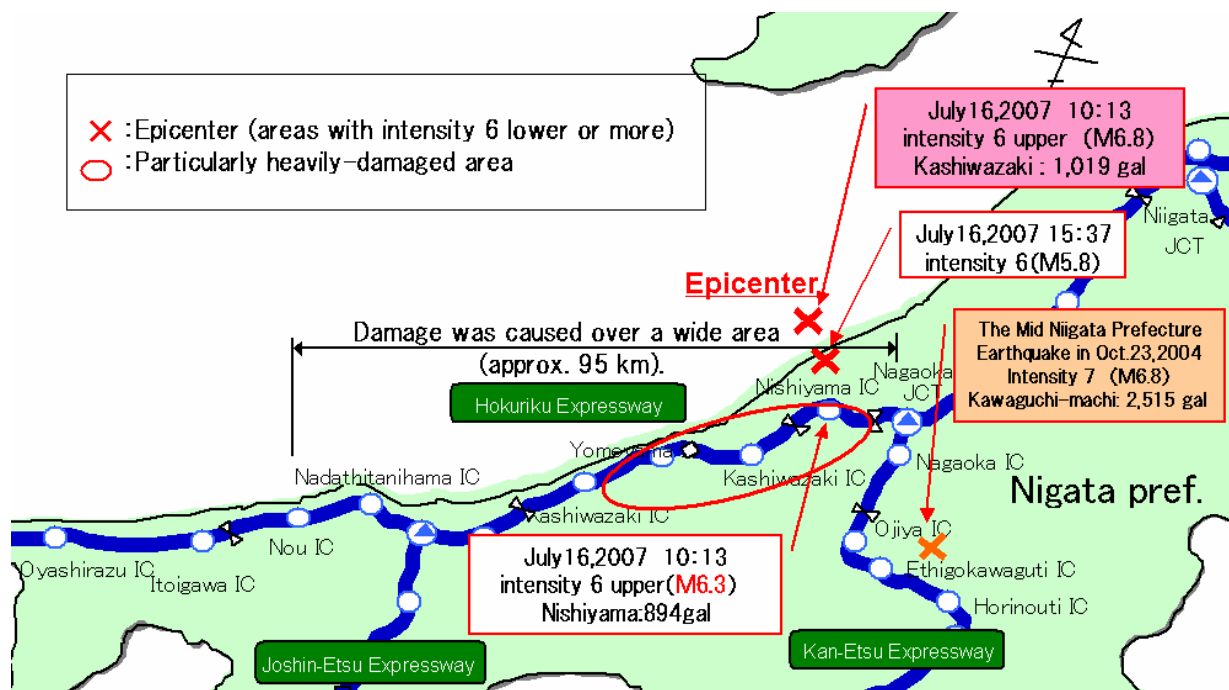


Figure 1. Epicenter and expressways

## 2. DAMAGE ON THE EXPRESSWAY

As to the damage caused to the Hokuriku Expressway, rippling pavement and large difference in level on the road surface were detected in about a 40-kilometer-section that passes a soft ground region between the Kakizaki IC and the Nagaoka JCT of the expressway. Damage to structures such as bridges and tunnels was particularly great in the mountainous area between the Kakizaki IC and the Kashiwazaki IC (Fig. 2).

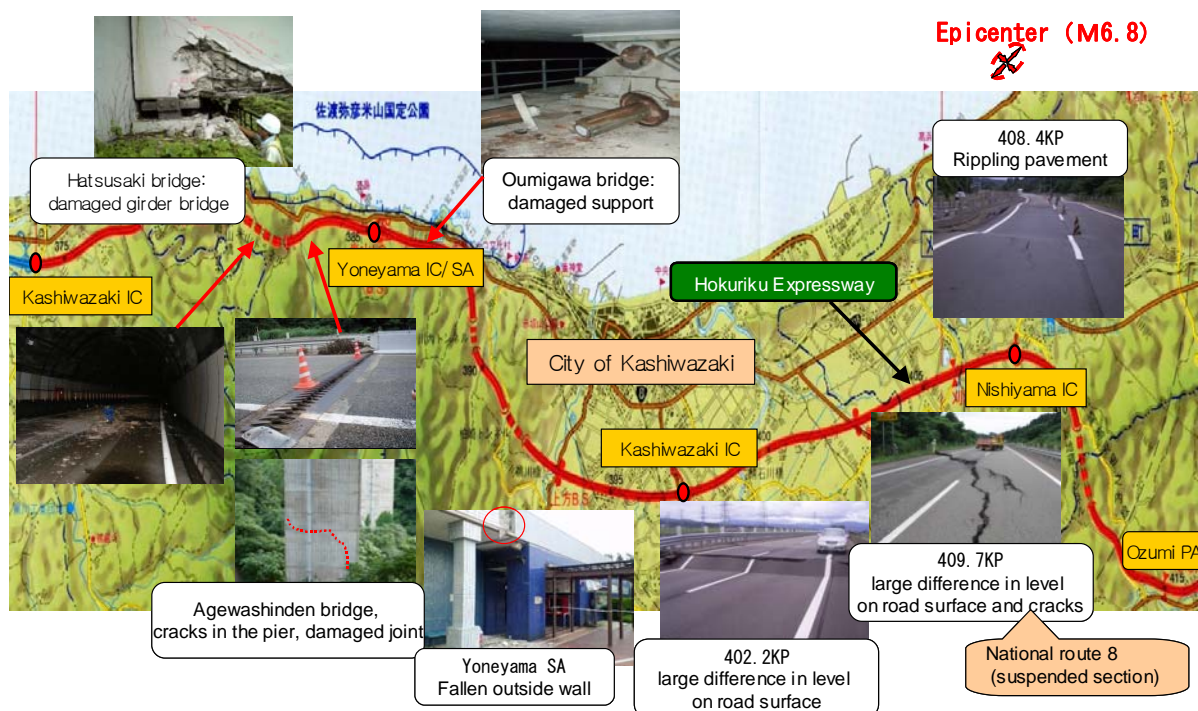
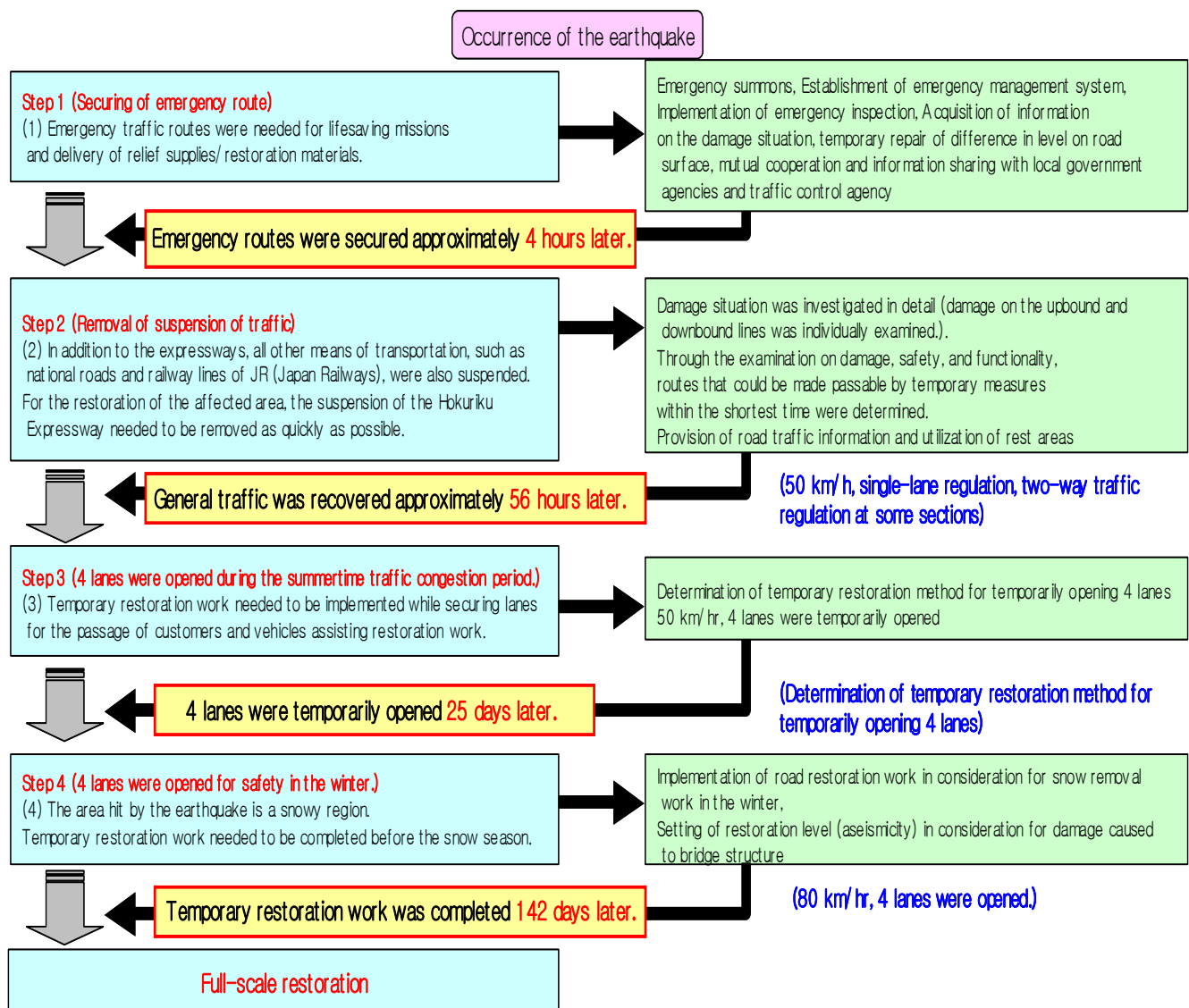


Figure 2 : Heavily-damaged places (between Kakizaki IC and Nagaoka JCT)

### 3. MEASURES TAKEN FOR QUICK TRAFFIC RECOVERY

In addition to the expressway, all other means of transportation, such as national roads and railway lines of JR (Japan Railways), were also suspended in the region hit by the earthquake. Since emergency routes were needed as quickly as possible for lifesaving missions and delivery of relief supplies/restoration materials, quick traffic recovery was sought by taking a step-by-step approach for the temporary restoration work (Table-1).

Table 1. Step-by-step temporary restoration toward quick traffic recovery



For the construction method used for the restoration work, inspections (emergent and detailed) were carried out by NEXCO group staff members and the like to grasp the damage situation (56 hours after the earthquake). Further, plans for temporary and full-scale restoration were determined based on the site inspection by academic experts and the like (Fig. 3).

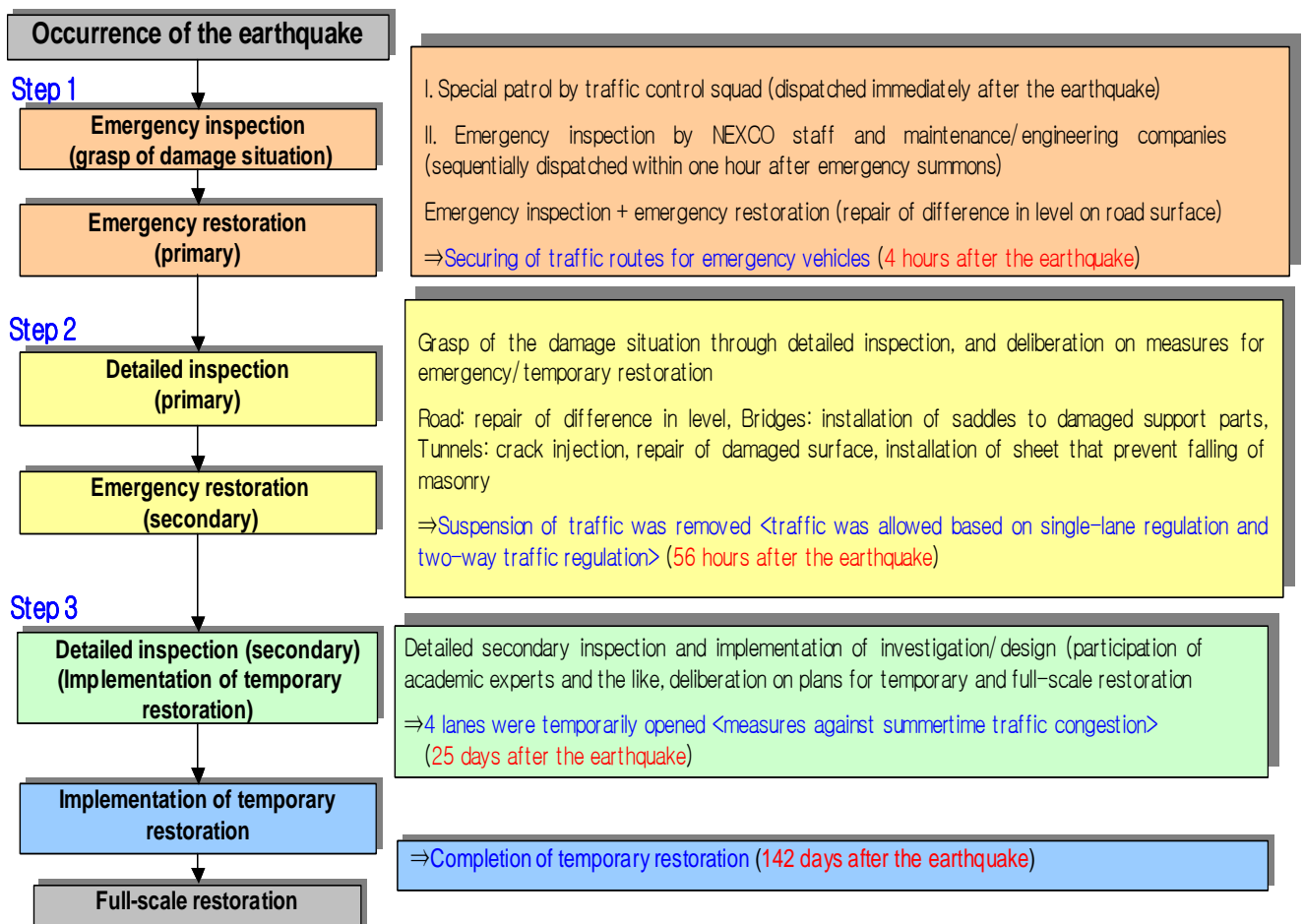


Figure 3. Inspection and restoration at each step

### 3.1 Securing of routes for emergency vehicles (4 hours after the earthquake)

In order to secure a road surface on which emergency vehicles could drive slowly, emergency inspection was conducted, and stored sandbags were placed at the difference in level on the road surface. As a result, traffic routes were secured for emergency vehicles within a short period of time (approximately 4 hours after the earthquake), which greatly contributed to restoration work in the affected area (Photos 1 to 3).

The sandbags had been stored at the Nagaoka IC and the Kashiwazaki IC since the Mid Niigata Prefecture Earthquake in 2004, which was a magnitude 6.8 earthquake (seismic intensity of 7 in Kawaguchi-machi, Niigata) that occurred 4 years ago on October 23, 2004.



Photo 1. Repair of difference in level on road surface



Photo 2. Emergency inspection using stored sandbags



Photo 3. Stored sandbags

### 3.2 Securing of routes for general vehicles (56 hours after the earthquake)

After securing the routes for emergency vehicles, temporary restoration work, including repair of difference in level on the road surface and cutting work on protrusions with a road cutter, was carried out on an around-the-clock basis. Since the section between the Kakizaki IC and the Nishiyama IC was particularly heavily damaged, the traffic was regulated (single-lane regulation) so that the nearside lane and the overtaking lane were flexibly switched while securing the general traffic. In this way, the restoration work was efficiently implemented. Further, in the section between the Kakizaki IC and the Kashiwazaki IC, since damage was caused to many structures (Hatsusaki bridge, Agewashinden bridge, Oumigawa bridge, and Yoneyama tunnel), damage and safety/functionality was evaluated for each of the upbound and downbound lines, and the measures for removing the suspension of traffic within the shortest period of time were explored. Consequently, the two-way traffic regulation was selected.

As a result, at 18:00 p.m. on July 18, which was 56 hours after the earthquake, the suspension of traffic was completely removed by adopting the two-way traffic regulation (3 sections) and the single-lane regulation (Fig. 4).

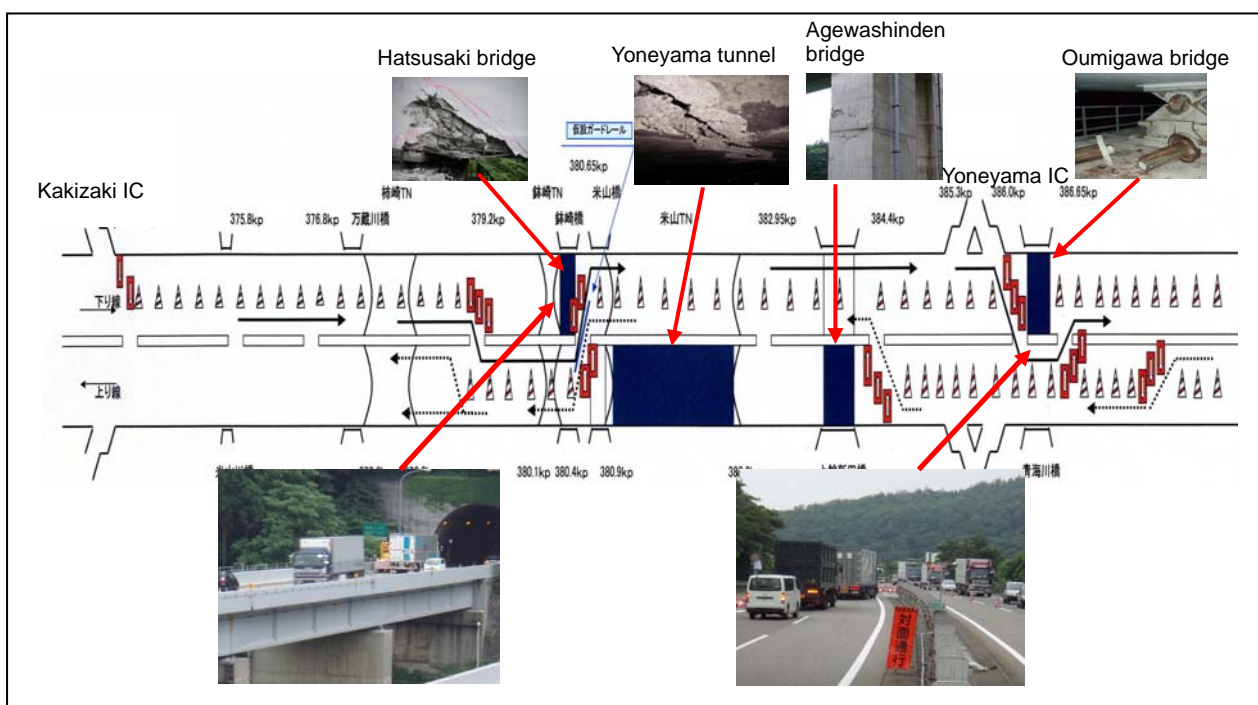


Figure 4. Passage of vehicles was allowed based on two-way traffic regulation

### 3.3 Securing of 4 lanes at an early stage (25 days after the earthquake)

#### (1) Measures against the summertime traffic congestion

Since heavy traffic congestion was expected during the traffic congestion period (the Bon period from August 10 to 20), restoration work to remove the two-way traffic regulation and the single-lane regulation was carried out on an around-the-clock basis. After the restoration work, a speed limit of 50 km/h was set and 4 lanes were temporarily opened on August 10, which was 25 days after the earthquake. Consequently, traffic congestion was avoided.



## (2) Measures for safety in the winter (securing of running safety)

After the Bon period, the single-lane regulation was again set, and before the full-fledged winter season, temporary restoration in consideration for customers' running safety and snow removal work was completed on December 5, 2007 (4 lanes were opened with a speed limit of 80 km/h).

### 3.4 Restoration assistance to the affected area

Since all other means of transportation (national roads and railway lines of JR) were also suspended immediately after the earthquake, quick recovery of the expressways played a significant role as routes to assist restoration activities in the affected area, which contributed to securing of smooth traffic (Fig. 5).

#### 1) Toll-free expressways

Since the national route 8 was suspended, it was necessary to secure detours and routes around the affected area. Thus, the expressway was made toll-free (the number of vehicles used the toll-free expressway: approximately 450,000, the number of vehicles assisting restoration work: approximately 80,000).

#### 2) Traffic control at interchange exit and entrance

To achieve smooth traffic and restoration in the affected area, the number of vehicles was controlled at the exit and entrance of the interchange (Kashiwazaki IC) in the affected area.

#### 3) Expressway as a detour

Because of the suspension of JR's Shin-Etsu Main Line, trucks and buses were used as alternative means of transportation, and the expressway was effectively used by these trucks and buses.

#### 4) Removal of waste (large trash) from collapsed houses

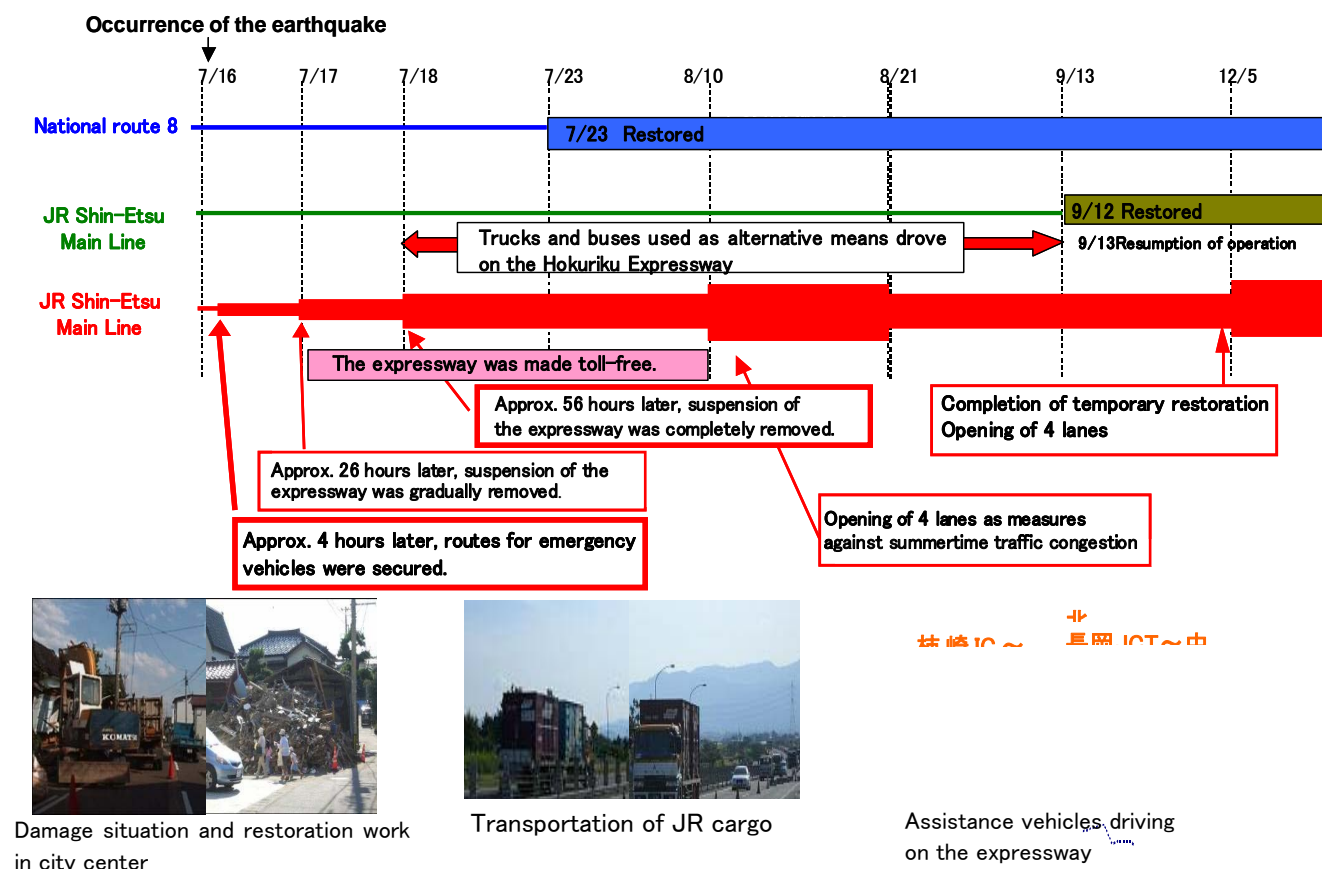


Figure 5. Process toward restoration of traffic infrastructure

#### **4. KEY FACTORS FOR SUCCESS OF QUICK TRAFFIC RECOVERY**

##### **(1) Optimum road structure**

The sites affected by the earthquake were 4 lane roads (upbound and downbound lines of bridges or tunnels were separately structured), and they had been maintained in good quality. Thus, no significant damage such as collapse of a bridge was reported. Also, by effectively utilizing upbound and downbound lines, restoration work was efficiently implemented.

##### **(2) Advanced knowledge of disaster prevention as well as robust guideline and the like (lessons learned from the Great Hanshin-Awaji Earthquake and the Mid Niigata Prefecture Earthquake in 2004)**

###### **1) Immediate establishment of emergency response system in the event of a disaster**

Emergency summons of staff members of NEXCO and partner companies at an early stage, and immediate establishment of initial response system for emergency inspection and the like.

###### **2) Flexible and effective emergency inspection**

Effective utilization of stored disaster-prevention materials

Implementation of emergency inspection while conducting temporary repair of difference in level on the road surface with stored sandbags

###### **3) Engineers' unerring judgment**

Rapid understanding of damage situation as well as early judgment of damage and safety/functionality

Determination of restoration method such as quick traffic recovery through two-way traffic regulation as well as unerring judgment of damage situation (damage and safety)

###### **4) Utilization of accumulated techniques**

Inheritance and handing down of past experience, work, and the like.

Day-and-night restoration work while securing routes for emergency vehicles and general vehicles.

##### **(3) Results achieved through effective utilization of the organization**

Immediate determination of restoration plans depending on the damage situation or the like as well as establishment of a cooperative support system

###### **1) Accurate technical advice by technical specialists**

###### **2) Procurement of emergency restoration equipment and materials as well as dispatch of personnel**

###### **3) Quick and accurate acquisition and provision of information (utilization of organization such as traffic control center on an around-the-clock basis as well as utilization of various types of equipment)**

###### **4) Immediate action from partner companies (disaster-prevention agreement as well as voluntary cooperation)**

#### **5. CONCLUSION**

While the earthquake caused damage on many parts of the expressways in the affected area, since the expressways were designated emergency transport routes, it was absolutely necessary to recovery the traffic flow as soon as possible.

The lessons learned through the earthquake recovery work include importance of daily preparedness for setting up a risk-management system. The following points were reconfirmed:

1) Importance of networked expressways

(A detour to a networked expressway, such as Kan-Etsu Expressway, Joshin-Etsu expressway, or Ban-Etsu Expressway, was possible when the Hokuriku Expressway was suspended)

2) Advantages of 4-lane expressways

(Restoration work was implemented while allowing the passage of vehicles)

3) Mutual cooperation and information-sharing with local government agencies and traffic control agency

(Contributed to restoration work and smooth traffic recovery in the affected area)

Above all, each staff member of the NEXCO group was filled with a sense of mission to make the expressways available as soon as possible and to contribute to the restoration work for the affected area. In addition, the great awareness of disaster prevention was also the driving force. After the temporary restoration work, thanks to the understandings and cooperation of customers and relevant organizations, the full-scale restoration work to recover the fully functioning expressways was completed in December, 2008. In closing, the deepest appreciation goes to the academic experts who enlightened us on the various aspects in earthquake restoration work and to the people who engaged in the construction work on an around-the-clock basis.

END